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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/918,463	08/01/2001	Yongju Jung	1567.1014	2888

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EXAMINER	
DOVE, TRACY MAE	
ART UNIT	**PAPER NUMBER**
1745	

DATE MAILED: 08/12/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/918,463	JUNG ET AL.	
	Examiner	Art Unit	
	Tracy Dove	1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 June 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-35* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-35* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

This Office Action is in response to the communication filed on 6/3/04. Applicant's arguments have been considered, but are not persuasive. Claims 1-35 remain rejected.

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 6/3/04 has been entered.

Claim Objections

Claim 17 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 17 does not further limit claim 1.

Claim 18 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 18 does not further limit claim 12.

Claim 28 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 28 does not further limit claim 24.

Claim 29 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 29 does not further limit claim 25.

Claim 30 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 30 does not further limit claim 26.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 12-16, 18 and 33-35 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claims 12 and 33 recite "wherein the mixed organic solvent includes less than 50% by weight of the weak polar solvent", which is not supported by the specification as filed.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 11, 16, 27-35 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 11 recites "the electrolyte salt", which should be "the sulfur-containing electrolyte salt" in accordance with claim 1. Furthermore, the only sulfur-containing salt listed in claim 11 is lithium trifluoromethane sulfonimide. Therefore, all other salts listed in claim 11 should be deleted because they do not contain sulfur.

Claim 16 recites "the lithium salt", which should be "the sulfur-containing electrolyte salt" in accordance with claim 12. Furthermore, the only sulfur-containing salt listed in claim 16 is lithium trifluoromethane sulfonimide. Therefore, all other salts listed in claim 16 should be deleted because they do not contain sulfur.

Claim 27 recites "further comprising a third solvent comprising a remaining one the weak polar. . .such that said first, second and third solvent are different solvents", which is indefinite. Both "said first solvent" and "said second solvent" lack antecedent basis. Furthermore, claim 19 already recites an electrolyte solvent comprising three solvents, thus, it is unclear what "a third solvent" encompasses. Claims 28-30 is similarly rejected.

Claim 31 recites "a third solvent" and "one of said first or second solvents". The phrase "one of said first or second solvents" lacks antecedent basis. The since claim 19 already recites three solvents, it is unclear what "a third solvent" encompasses.

Claim 32 recites "of a same group as one of said first, second or third solvents", which is indefinite. The phrase "said first, second or third solvents" lacks antecedent basis.

Claim 33 recites "a material in which lithium intercalation reversibly occurs selected from the group consisting of a lithium alloy and a lithium metal", however, these materials do not intercalate lithium. Examiner suggest the claim be amended to recite "a negative active material selected from the group consisting of a material in which lithium intercalation reversibly occurs, a lithium alloy and a lithium metal".

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-33 are rejected under 35 U.S.C. 102(e) as being anticipated by Chu et al., US 6,030,720.

Chu teaches electrolyte solvents for lithium-sulfur batteries. The disclosed solvents include at least one ethoxy repeating unit compound solvent such as a glyme. The solvent may further include a donor solvent and/or an acceptor solvent. The donor solvent may be hexamethylphosphoramide, dimethylsulfoxide, dimethylacetamide or dimethylformamide. The solvents assist in solvation of lithium ions, sulfide and polysulfide anions. See abstract. Claim 5 recites the main solvent is tetraglyme (weak polar solvent of instant claim 5). Claim 8 recites the donor solvent may be at least one of hexamethylphosphoramide, dimethylsulfoxide, dimethylacetamide or dimethylformamide (strong polar solvent of instant claim 6). It should be understood that the electrolyte solvents of this invention may also include other cosolvents which

do not necessarily fall into the donor solvent and acceptor solvent classes. Examples of such additional co-solvents include sulfolane (strong polar), tetrahydrofuran (lithium protection solvent of claim 7), dioxolane (lithium protection solvent of claim 7), dialkyl carbonates (weak polar), propylene carbonate (strong polar), ethylene carbonate (strong polar), dimethyl carbonate, diethyl carbonate, butyrolactone (strong polar), dimethoxyethane (weak polar) and combinations of such liquids (col. 14, lines 33-41). Thus, Chu teaches a mixed solvent comprising a weak polar solvent, a strong polar solvent and a lithium protection solvent, as defined by the present invention.

The positive electrode includes a sulfur-based material such as elemental sulfur and the negative electrode includes lithium metal (col. 5, line 55-col. 6, line 21). The positive electrode may include an electrically conductive material (col. 8, lines 35-42). The electrolyte may include an electrolyte salt such as lithium trifluoromethanesulfonimide (sulfur-containing), lithium triflate, lithium perchlorate, $LiPF_6$ and $LiBF_4$ (col. 14, lines 56-67). The protection layer 8 is formed on the negative electrode (Fig. 1 and 2B).

Regarding claims 8-10 and 13-15, Chu teaches that the negative electrode may comprise any metal and polyether electrolytes are known to transport divalent ions such as zinc (col. 20, lines 40-50). The materials for the negative electrode include a lithium alloy. Preferred alloys include lithium aluminum, lithium silicon (Si) and lithium tin alloys. Other metallic electrodes may include aluminum (Al), zinc (Zn), lead (Pb) and their alloys (col. 21, lines 1-9). The positive electrode may include sulfides or polysulfides or the metal or metals found in the negative electrode (col. 5, lines 55-65). The positive electrode may include metal sulfide additives (col. 16, lines 39-65).

Regarding claims 19 and 20, identical solvents will have the same ability to dissolve polysulfides, elemental sulfur and/or lithium polysulfide.

Regarding claims 21 and 22, identical solvents will have the same dielectric coefficients. Chu teaches that a desirable property of both donor and acceptor co-solvents used is a high dielectric constant. Such solvents generally promote dissociation of an ionic solute or a contact ion-pair (col. 14, lines 1-5).

Regarding claim 33, Example 1 teaches elemental sulfur, carbon black and polyethylene oxide in a solution of acetonitrile were mixed to form a slurry. The slurry was applied to a current collector to form the positive electrode. Figure 1 shows a lithium/liquid electrolyte/sulfur cell 10 having a positive electrode 18 with positive collector 20, a negative electrode 14 with negative collector 12, a separator 16 and a protective layer 8.

Furthermore Chu teaches the liquid electrolyte solvent includes "about 50 to 100% by weight of the main solvent (weak polar solvent(s)), excluding salts (14:42-55). The disclosure of "about 50%" includes values slightly below "50%", thus the claim limitation "less than 50%" is still anticipated by Chu. Note this limitation has been rejected as containing new matter.

Thus the claims are anticipated.

»

Claims 1-33 are rejected under 35 U.S.C. 102(e) as being anticipated by Nimon et al., US 6,225,002.

Nimon discloses dioxolane as a protector for lithium (negative) electrodes of lithium-sulfur batteries (title). Battery cells containing dioxolane as an electrolyte co-solvent exhibit improved cycling performance over cells not containing dioxolane (abstract). Figure 9 shows a

mixed solvent of tetraglyme (weak polar solvent) and dioxolane (lithium protection solvent). The electrolyte includes a main solvent having the chemical formula shown in col. 3, line 18 and a co-solvent wherein the co-solvent includes dioxolane. The electrolyte may also include an additional co-solvent having a donor number of at least about 13 (col. 3, lines 15-25). The battery includes a sulfur-based positive electrode. Donor solvents (strong polar solvents) are disclosed in col. 7, lines 14-22. The electrolyte may include other co-solvents such as those listed on col. 7, lines 32-41. The lithium salts of the electrolyte are listed in col. 7, lines 42-46.

Note Chu et al., US 6,030,720 is incorporated by reference in Nimon (col. 6, lines 26-29). See discussion of Chu above regarding claims 1-33.

Thus the claims are anticipated.

»

Claims 1-35 are rejected under 35 U.S.C. 102(e) as being anticipated by Katz et al., US 6,358,643.

Katz teaches a liquid electrolyte lithium-sulfur battery. It is generally desirably that the positive electrode have a relatively high porosity, possibly as high as 95% or more. Generally, higher porosity electrodes allow fabrication of cells with higher laminate energy densities because less electronic conductor is required. Of course, an electrode's porosity, capacity and thickness are linked so that setting two of these parameters fixes the other.

Note Chu et al., US 6,030,720 is incorporated by reference in Katz (col. 1, lines 21-22). See discussion of Chu above regarding claims 1-33.

Thus the claims are anticipated.

Response to Arguments

Applicant's arguments filed 6/3/04 have been fully considered but they are not persuasive.

35 U.S.C. 112, first paragraph

Applicant argues Examples 2-5 clearly recite embodiments in which the mixed organic solvent is less than 50% by weight of the weak polar solvent (refers to Table 1). However, Table 1 teaches volume ratios (not weight percent ratios). Furthermore, only the specific volume ratios for the specific solvents used for the mixed organic solvent are supported by Table 1. Thus, the 35 U.S.C. 112, 1st, rejection is maintained.

35 U.S.C. 112, second paragraph

The amendment overcomes the 35 U.S.C. 112, 2nd, rejections of claims 1, 12 and 19. However, the rejection of claim 33 regarding the negative active material is maintained.

35 U.S.C. 102(e)

Applicant argues Chu et al. does not teach three different solvents, however, Chu teaches that more than one cosolvent may be used (14:15-41).

Applicant argues Nimon does not teach three different solvents, however, Nimon teaches that more than one cosolvent may be used (3:15-25).

Applicant argues Katz does not teach three different solvents, however, Katz teaches that more than one cosolvent may be used (Chu is incorporated into Katz; 1:20-21).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tracy Dove whose telephone number is 571-272-1285. The examiner can normally be reached on Monday-Thursday (9:00-7:30).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Pat Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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